

Examination of health effects and long-term impacts of deployments of multiple tag types on blue, humpback, and gray whales in the eastern North Pacific

Annual report for 2011 prepared by
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Award Number: N000141010902
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LONG-TERM GOALS

Despite extensive use of implant tags for more than 30 years, only limited studies have been conducted of the health effects and long-term consequences of tag deployments on whales. This field is rapidly expanding including increased use of deep penetration tags on many populations including critically endangered populations such as the North Pacific right whale and the western gray whale. Studies of North Atlantic rights whales revealed a wide variety of conditions of the tag site after deployments of penetration tags varying from very minor divots to more extensive swellings.

Our goal is to provide new insights into the long term consequences of different types of tags on several additional species of large whales including blue, humpback, and gray whales by conducting long term follow up of previously tagged individuals in the eastern North Pacific. We examine the long term impacts on health, reproduction, and mortality unitizing the past deployments of implant and suction cup tags on blue, humpback, and gray whales in the eastern North Pacific and our extensive monitoring of these populations.

OBJECTIVES

Overall objectives for multi-year project:

1. Examine the long-term survival of tagged animals in relation to animals that were not tagged.
2. Test for differences in the visual health status of tagged versus untagged animals.
3. Examine the condition of the tag site and evaluate healing in tagged animals.

Objectives for the initial year included

- Collaboration with OSU to obtain historical ID photographs of tagged whales
- Collaboration with OSU genetics lab to conduct genetic tests on whales biopsied during tagging to aid in future identification
- Modification of digital databases to code and maintain additional views of target species to enable researchers to examine tag impact areas as well as general health of the whale
- Standardization of language for Tag Type in the historical database to facilitate analysis of impact on individual whales due to different tag types and deployment methods.
- Comparison begun between CICIMAR and CRC catalogs to increase known histories of individual blue whales

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE SEP 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Examination of health effects and long-term impacts of deployments of multiple tag types on blue, humpback, and gray whales in the eastern North Pacific				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Cascadia Research Collective, 218 ? W, 4th Ave, Olympia, WA, 98501				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 6	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

APPROACH AND WORK PLAN

We proposed to address long term impacts of tagging by conducting detailed follow-up of blue, humpback, and gray whales that have had tags deployed on them to examine site healing, health, and any long-term consequences of tag deployment on reproduction, health, or survival. Our focus on three species of baleen whales in the Eastern North Pacific represents an ideal test case to study this for two primary reasons:

1. Some of the longest histories of tag deployments have been conducted in this area on these species. This includes over 400 deployments of a wide variety of tags ranging from suction-cup, external tags anchored into blubber, and full implant tags on blue whales. This sample includes the largest number of implant tag deployments of any whale population (OSU implant tag deployments on 186 eastern North Pacific blue whales, for example).
2. Extensive sighting histories of blue, humpback, and seasonal-resident gray whales are available off the US West Coast from photo-identification studies; these studies have been virtually uninterrupted since 1986 with continued monitoring planned. In all three species, the majority of the population has been photo-identified and resighting rates are very high. Seasonal resident gray whales in this region have annual resighting rates of 70% or more and catalogs of identified blue and humpback number over 2,000 individuals each.

We used both photographs and genetics to conduct the first systematic reconciliation of the animals tagged with the long-term photo-ID datasets. Photographs and video taken from deployments were used to catalog both the photo-ID identities and the markings immediately around the tag site of whales to add to those where a match between tagged animal and photo-ID has already been made and those gathered of during the study. Additional determinations of identity is being made based on genetic matches between samples taken from about 100 implant-tagged whales and those collected from animals in these populations.

WORK COMPLETED

The following major areas of work were completed in the initial year of effort:

1. OSU genetics lab (Dr Scott Baker) conducted genetic analyses of OSU tagged blue whales to aid in identification of tagged animals and genetic matching to animals encountered later.
2. We have collaborated with OSU's Marine Mammal Institute Radio Telemetry Group to obtain photographs and video of blue whales that have been previously tagged by OSU. This work is still underway to identify and match photographs and images from video taken during tag deployments that have not been matched yet.
3. We have conducted additional photo-ID matches and comparisons of these to add additional known identified whales that have been tagged.
4. We have compiled identifications and sightings of follow up photographs and sightings of eastern North Pacific gray whales tagged in 2009.
5. We have conducted additional field work including work in collaboration with other studies obtaining photographs of blue whales including for photographic identification, for examination of potential tag sites, and for visual health assessment of blue whales.
6. Held preliminary meetings with our veterinary/pathology team to discuss methods of categorizing tag injuries.

RESULTS

Summarized below are the results of different components of the research completed to date. These include the results of genetic analyses conducted of whales satellite tagged by OSU as well as some of the preliminary results of determining the photo-ID of blue and gray whales that had been tagged to be able to conduct follow up examinations.

Genetic analyses conducted

Genetic analyses have been conducted of samples collected from blue, humpback, and gray whales satellite tagged by OSU (Table 1). These will be used to help test genetic matches with animals showing injuries to help verify if these might be from tagging.

Table 1. Details on analysis of samples collected from tagged animals and analyzed by OSU genetics lab for this study. Details also include the number of samples haplotyped (or sequenced to be haplotyped in the case of humpback and gray whales), the number of animals for which sex was identified, and the number of individuals that have been genotyped.

	Blue whale	Humpback whale	Gray whale
Total samples available from tagged animals	68	34	14 (all 2009)
Haplotype	51	20	9
Sex	32	10	13
Microsatellites	33 – to be analyzed	3	0

Gray whales

Of 18 gray whales OSU satellite tagged in the Pacific Northwest in fall 2009, 17 were photo-identified and all were known animals present in Cascadia's catalog of eastern North Pacific gray whales. (Table 2). Cascadia maintains a catalog of eastern North Pacific gray whales that consists of about 1,000 individuals identified off California, Oregon, Washington, and British Columbia by Cascadia and other collaborators (under a project primarily sponsored by the National Marine Mammal Laboratory). The core of this catalog is the estimated 200-250 gray whales that regularly use the Pacific Northwest for feeding each spring, summer, and fall. In addition to photo-ID, recent genetics studies have revealed significant differences in mtDNA between these animals and other eastern North Pacific gray whales suggesting these should be treated as an independent demographic unit (Frasier et al. 2011, Lang et al. In prep). Analysis of the follow up these satellite tagged whales is being conducted under this project and has been undertaken by OSU and will be included in a conference presentation by Craig Hayslip at the Biennial Marine Mammal Conference in Tampa.

Table 2. Identification histories of gray whales that were tagged by OSU in fall 2009. These

CRC-			1985	1991	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ID	Contributed IDs	Date																			
32	OSU-PTT-5938	04-Dec-09	1						2	16			18	3	6			2		1	
89	OSU-PTT-23029	05-Oct-09			2				20	21	30	13	4	23	11	19	17	8	16	4	17
164	OSU-PTT-10836	14-Nov-09		1		7					3	1	1			1	1		1	3	14
196	OSU-PTT-10838	27-Oct-09					1				2		1	9		6	14	6	8	6	23
205	OSU-PTT-10842	25-Nov-09					2	9		6	1	3	3	5					7	9	1
206	OSU-PTT-5923	05-Oct-09					4		3	2	1	3	4	3				2		2	1
215	OSU-PTT-5670	27-Oct-09					2		1				5	4	1			3		2	
291	OSU-PTT-23032	14-Nov-09							2	2	1	3	6	10	4	1	5		1	1	3
302	OSU-PTT-5801	24-Sep-09							4	8	1		4	14	10	1	15	6	15	6	17
411	OSU-PTT-23038	15-Nov-09								1	4	8	4					2	3	2	6
525	OSU-PTT-847	17-Sep-09									1	2	1		1	2	1	3	20	13	5
537	OSU-PTT-831	17-Sep-09									2			1				1	1	1	5
615	OSU-PTT-23033	03-Dec-09										1	1						2	1	5
643	OSU-PTT-4174	27-Oct-09										1	2	1		2			3	2	1
659	OSU-PTT-827	17-Sep-09											2		5		1		1	3	5
854	OSU-PTT1385	17-Sep-09														1			3	3	2
981	OSU-PTT-23041	04-Nov-09																1		1	5

Blue whales

At present 61 tagged blue whales have been identified. As a result of the initial work with OSU, additional blue whales that were tagged have been identified in Cascadia's photo-ID catalog. For 2004 for example, ten photo-IDs of tagged animals were compared to the historical catalog with seven matching and being known animals. Of these seven matches five of these whales have been sighted since 2004. Work that remains to be completed includes reviewing and selecting images from video and negatives at OSU and sending these images along with data to Cascadia.

While blue whales satellite tagged by OSU are one focus of this project, we also have compiled the identifications of blue whales that had other deployed tags. A large sample is now available of blue whales that had suction-cup tags applied (see for example Oleson et al. 2007, Calambokidis et al. 2008, Goldbogen et al. 2011). While suction-cup tags have been considered lower impact than implant tags, some preliminary results indicate that in some cases these types of tags can cause injuries that penetrate the skin. Figure 1 shows a series of photographs of a blue whale tagged with a suction cup attached GPS tag on 21 September 2011 that show injury to skin.

In late 2010 and 2011, detailed photographs were obtained of blue whales off California to allow better assessment of health and also a detailed view of parts of the body where tags may have been applied. Typically in the past, only the portion of blue whales used in photographic identification were obtained so these recent photographs will provide a better basis of assessment of health and tag condition than had been available. Once we have been able to complete the photo-ID determination of all tagged whales we will conduct a careful review of the tag site of each tagged whale over the year of tagging and in any photographs taken in subsequent years as photographs are available.



Figure 1. Progression of photographs of a blue whale suction cup tagged on 21 September 2011 and then follow up photographs taken on 3-7 October 2011 (including photograph with 2nd tag, an Acousonde attached). These show an injury at the site of the suction cup deployment that penetrates the skin.

IMPACT/APPLICATIONS

The study will provide new insight into the long term consequences of implant and other tags in terms of healing of injuries from tags and impacts on health and survival. These types of tags provide important information for both ecosystem health and public education but fully understanding the long-term impacts of these tags is important to achieve these ends.

RELATED PROJECTS

There are a number of projects that are related to the one proposed here. OSU continues to conduct detailed examination of gray whales that were satellite tagged including follow up field work that is in addition to what is being done as a part of the project reported here. The work proposed here also ties into the long-term photographic identification research being conducted by Cascadia Research of blue, humpback and gray whales (with support from the National Marine Mammal Laboratory, and Southwest Fisheries Science Center). Follow up photographs taken for this study as well as additional tagging of whales are also being obtained related to other research on blue whales such as the SOCAL Behavioral Response Study and examination of ship strike impacts.

REFERENCES

CALAMBOKIDIS, J., LAAKE, J.L. AND KLIMIK, A. 2010. Abundance and population structure of seasonal gray whales in the Pacific Northwest 1978-2008. Paper SC/62/BRG32 presented to

the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 50pp. [Paper available from the Office of this Journal]

CALAMBOKIDIS, J., G.S. SCHORR, G.H. STEIGER, J. FRANCIS, M. BAKHTIARI, G. MARSHALL, E. OLESON, D. GENDRON AND K. ROBERTSON. 2008. Insights into the underwater diving, feeding, and calling behavior of blue whales from a suction-cup attached video-imaging tag (Cittercam). *Marine Technology Society Journal* 41:15-25.

FRASIER, T.R., KOROSCIL, S.M., WHITE, B.N. AND DARLING, J.D. 2010. Population structure in the eastern North Pacific gray whale: Implications for management of aboriginal whaling. Paper SC/62/AWMP1 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 14pp. [Paper available from the Office of this Journal] [2010]

GOLDBOGEN, J. A., J. CALAMBOKIDIS, E. OLESON, J. POTVIN, N. D. PYENSON, G. SCHORR, R. E. SHADWICK. 2011. Mechanics and energetics of blue whale lunge feeding: efficiency dependence on prey density. *Journal of Experimental Biology*.

LANG, A.R., WELLER, D.W., LEDUC, R.G., BURDIN, A.M. AND BROWNELL, R.L., JR. 2010. Genetic differentiation between western and eastern (*Eschrichtius robustus*) gray whale populations using microsatellite markers. Paper SC/62/BRG11 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 18pp. [Paper available from the Office of this Journal]

OLESON, E. M., J. CALAMBOKIDIS, W. C. BURGESS, M. A. McDONALD, C. A. LEDUC and J. A. HILDEBRAND. 2007a. Behavioral context of call production by eastern North Pacific blue whales. *Marine Ecology Progress Series* **330**: 269-284.